MechPart Pro

B2B Precision Manufacturing · Technical White Paper

MATERIALS

Material Selection Guide for Precision Components

A practical framework for choosing metals and engineering plastics — with mechanical properties, machinability, finishing and cost considerations for CNC, casting, forging and molded parts.

What's inside

1. How to approach material selection

Material choice is one of the highest-leverage decisions in a part's life. It sets mechanical performance, corrosion and temperature resistance, weight, machinability, finishing options and — often dominating the total — cost. The right approach is to start from the part's single hardest requirement and work outward, rather than defaulting to a familiar material.

A four-step method

- **Define the governing requirement.** Strength, weight, temperature, corrosion, conductivity, biocompatibility or transparency — identify the one the part cannot compromise on.
- **Shortlist by that requirement.** Eliminate materials that cannot meet it before comparing anything else.
- **Balance secondary factors.** Among survivors, weigh machinability, finishing, availability and cost.
- **Confirm manufacturability.** Verify the material suits the intended process and tolerances before release.

The tables that follow summarise the metals and plastics MechPart Pro machines and forms most often, so the shortlist step is fast.

2. Metals at a glance

Six metal families cover the vast majority of precision parts. Aluminium dominates where weight and machinability matter; stainless where corrosion resistance is key; carbon and alloy steels where strength-per-cost rules; titanium where strength-to-weight and biocompatibility justify the cost; brass and copper for conductivity; tool steels for wear.

Material	Density	Key strength	Machinability	Relative cost
Aluminium (6061/7075)	2.70 g/cm3	Light, corrosion-resistant, anodises	Excellent	Low-Med
Stainless (304/316/17-4)	~8.0 g/cm3	Corrosion & heat resistance	Fair (303 good)	Medium

Material	Density	Key strength	Machinability	Relative cost
Carbon/alloy steel (1045/4140)	7.85 g/cm3	High strength per cost	Good	Low
Titanium (Gr2/Gr5)	4.43 g/cm3	Strength-to-weight, biocompatible	Poor	High
Brass / Copper (C360/C110)	~8.5 g/cm3	Electrical & thermal conductivity	Excellent (C360)	Medium
Tool steel (D2/H13/M2)	~7.7 g/cm3	Hardness & wear resistance	Fair annealed	Med-High

Choosing among the metals

- **Weight critical?** Aluminium first, titanium when you also need strength or corrosion resistance.
- **Corrosion / hygiene?** 316 for marine and chemical, 304 for general, titanium for the harshest service.
- **Strength per cost?** 4140/4340 alloy steels, heat-treated after machining.
- **Conductivity?** C110 copper for electrical, C360 brass for fast-machined conductive parts.

3. Engineering plastics at a glance

Machined plastics deliver fast, tool-free precision for prototypes, low volumes and parts needing chemical resistance, low friction or electrical insulation. Choose by the part's hardest demand: temperature, chemical exposure, friction, transparency or simple economy.

Plastic	Max service temp	Standout property	Typical use
ABS	~80 C	Tough, easy to machine/bond	Enclosures, prototypes
Nylon (PA)	~120 C	Wear-resistant, self-lubricating	Gears, bushings

Plastic	Max service temp	Standout property	Typical use
POM / Delrin	~100 C	Stiff, low-friction, stable	Precision machined parts
Polycarbonate	~120 C	Clear, very high impact	Guards, lenses
PEEK	~250 C	Metal-like strength, chemical resistance	Aerospace, medical, semiconductor

Plastics expand and absorb moisture far more than metals; tolerance them accordingly and stress-relieve critical parts.

4. Selection by application

Aerospace & defence

Ti-6Al-4V, 7075-T6 aluminium and 15-5/17-4PH stainless dominate, chosen for strength-to-weight and traceability under AS9100D.

Medical devices

Implant-grade titanium (Gr23 ELI), 316L stainless and PEEK lead, selected for biocompatibility, corrosion resistance and the ability to take fine, cleanable finishes under ISO 13485.

Automotive & EV

Aluminium and magnesium for lightweighting, 4140 for stressed parts, with process and material tuned to hit cost-per-part at volume under IATF 16949.

Electronics

6063/6061 aluminium and copper for heat sinks and RF enclosures, balancing thermal performance with cosmetic anodised finishes.

5. Finishing & how MechPart helps

Material choice and finish are linked: aluminium anodises, stainless passivates and electropolishes, steels need plating or coating for corrosion protection, and most plastics are used as-machined or vapour-polished. Specify finish only where function or appearance requires it to keep cost down.

MechPart Pro machines and forms the full range above with full material certification on every order. Share your part's governing requirement and target cost, and our engineers will recommend a material and process, flag any manufacturability risks, and quote within 24 hours. Browse live material data at mechpart.io/?page=materials.